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WHEN SHALL WE TREPHINE IN FRACTURES OF THE SKULL?

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Not so very long ago (a dozen years) the only indications supposed to demand operation, in fractures of the skull, were embraced in these rules:

1. In *compound, comminuted* fractures, *with or without brain symptoms*, the depressed bone should be elevated and the fragments removed to be rid of the irritation the spiculæ will produce, and to avoid the inflammation of the brain and its membranes such irritation would be likely to set up.

2. In all cases of *local* injury to the skull, whether fracture or bruise, followed by a clear evidence of inflammation of bone and persistent symptoms of brain irritation, or of pus between the bone and dura mater, the trephine should be resorted to.

3. Punctured fractures almost invariably lead to inflammation of brain, sooner or later,—are the most dangerous of all fractures—and require the use of the trephine *with or without* the presence of brain symptoms.

Upon the contrary it was thought: "never operate unless the symptoms *are urgent*" (with the above exceptions); in diffused injuries to the cranium and its contents, "operative procedures are *never* justifiable, since the injury is not limited to one point and cannot be relieved by an operation"; and finally "in compound fractures, *even with depression*, if not comminuted, an operation should be performed unless the symptoms of compression from local pressure are great;" trephining in gun-shot fractures was almost unknown. Such were the directions of one of our best teachers in 1880.

Now we know that we should operate *in every case* of fracture with depression, even if there be no symptoms whatever; in many diffused injuries trephining is indicated; gun-shot wounds of the skull should invariably be followed by operation, and some go so far to say that even

*Read before the Jackson County Medical Society.

simple fissure ought to be treated by trephining. Thus the late Dr. D Hayes Agnew (*University Medical Magazine*, October 1891) in discussing the subject of traumatic epilepsy says: "It is not saying too much to assume that surgery is responsible for the great majority of traumatic epilepsies. The old members of our profession cannot, of course, be held responsible for not practising those methods which time, observation, vivisection and knowledge derived from collateral branches of study have made possible. They said that human life is too precious a thing to be jeopardized by overstepping the bounds of a wise conservatism. On the other hand no charity can release him from responsibility, who, from being wedded to old traditions and who can discover nothing valuable outside of his own narrow horizon, declines to keep step in the grand procession. The doctrine that depressed fractures of the skull without symptoms required no operative interference, a doctrine which in the past has been so deeply rooted in the professional mind, I hold to be responsible for very many of the unfortunate sequels of head injuries. However small may be the depression which follows a fracture of the cranium, save in one or two localities, it will encroach enough upon the dural nerves to cause more or less irritation, which, though insignificant at first and not at all recognizable to the consciousness of the patient, yet eventually will be propagated to the cortex and brain ganglia until finally the paroxysmal explosion occurs. * * * * Whenever, therefore, in my judgment, the profession can accept the doctrine that *all depressed fractures of the cranium, however slight may be the depression, and entirely irrespective of pressure symptoms, are proper subjects for trephining*, then will traumatic epilepsy largely disappear; indeed, I am sure that he who shall propose to tabulate at the end of the next twenty-five years the cases of epilepsy will find, as compared with the present time, a meagre supply for his purpose. It is not improbable indeed, in view of the greatly diminished risk from trephining, *that the operation will be extended even to cases of simple fracture or fissure of the skull.*"

The reason assigned by Dr. Agnew is that no surgeon, however skilled, can determine, without operation, what has happened inside the skull, even in a simple fracture; therefore the necessity for inspection of the interior as well as exterior surface; which is in conformity with the statement of Bouillaud that no blow upon the head, however insignificant it may appear to be, is too slight to excite anxiety regarding the future. For the sequel may be long delayed; as says Dr. Allen McLane Hamilton (*Pepper's System of Medicine*, Vol. v. p, 471): "It is quite common to find old fractures, with depressions which have existed for years without any seeming bad effects, suddenly lighting up convulsions under the influence of some new excitement." Nor, as Agnew says, must there be anything more than a simple fracture to produce disastrous results years after the reception of the injury; for these apparently simple fissures may be attended by grave intra-cranial conditions. No

man can say that a fracture of the skull, however simple it may appear, will not be followed by meningeal hæmorrhage,or later by epilepsy, insanity, etc. A case which I saw some years ago in consultation with Dr. L. A. Berger, of this city forcibly illustrates this point.

CASE I.—C. L.———, of German birth, age fifty-three, a furrier, of powerful build; was quiet, reserved, and modest in demeanor; not a drinking man; family history good. During the Franco-Prussian war (about 1870) he was struck with the butt of a musket (shown by scar over right parietal eminence and anteriorly). There was no apparent injury to skull, no fracture according to history of case, though he was unconscious for two or three days after time of injury; he went again into active service three weeks after receiving the blow. From 1871 to 1881, (when he came to America and married) his history is a blank. Since his marriage he has developed a peculiar condition; he is subject to attacks of vertigo, is seized with most violent fits of anger (from most trivial causes), often lasting two hours and terminating in an melancholic state continuing a day or two. During his last year of life he has been alternately morose, secretive, melancholic and negligent in his business, and extremely restless. On October 18, (1886) he became unusually restless; ran out of house and remained in country all day, walking; returned in evening completely exhausted and unable to account for his disappearence or whereabouts. October 20, no particular change except tendency to talk incessantly; pupils normal; no deviation on protrusion of tongue; no tremor or paralysis; physical functions unimpaired; temperature normal; sleep little and disturbed. He was given bromides and tonics. During next thirty days there was no perceptible change except that gradually a condition like dementia supervened. November 22, he became suddenly unconscious, stertorous breathing, pupils dilated, inability to swallow, pulse 120, temperature 100°. During day breathing assumed Cheyne-Stokes character and death occured twelve hours after onset of coma. *Autopsy.*—Post-mortem examination was made eighteen hours after death; present Drs. Berger, Eggers, Adams and Lanphear. Calvaria removed with difficulty, dura mater adherent; cloudy exudate beneath dura, at site of injury; also in pia. Dura thickened, opaque and inseparable from arachnoid from point of injury up to longitudinal sinus; here was a small piece of bone driven across longitudinal fissure and penetrating the falx cerebri; size of fragment, one inch long and one-sixth inch wide; no effusion or hæmorrhage in brain or ventricles; no other lesions discoverable upon most careful examination.

Here was a case of injury to the skull, with no fracture discoverable at time of accident; yet insanity resulted two years later and death from pachymeningitis sixteen years afterward. It is not improbable that if trephining had been done at time of injury no subsequent trouble would have occurred. The history of this case emphasizes the point I shall presently make, that all cases of local injury to the skull, accompanied by unconsciousness of more than an hour's duration should be trephined.

Another case in which there was no evidence of fracture at time of reception of injury—saved prolonged unconsciousness—yet one in which trephining would probably have prevented development of mental trouble, was the following (noticed in the KANSAS CITY MEDICAL INDEX, August 1888):

CASE II.—Isaac F———, age forty-one, laborer, family history unknown previous health excellent, was in September 1887, struck upon the head by falling

timbers. The external injury was not great, but he was comatose for a time, and the attending surgeon, Dr. N. J. Pettijohn, of Kansas City, desired to trephine near the site of injury; the consulting surgeons, however, demurred because the symptoms present were not of an alarming character, and he showed evidence of rallying. He eventually recovered consciousness, and was restored to fair physical health; but his mental condition is one of serious aspect. He was for some weeks recently under my care, with the object of determining, if possible, the justifiability of trephining now, and the point of selection for operation. I was unable to decide that there is *now* any local point of excitation (the only peripheral symptoms being a tingling and numbness of one little finger)—in other words, there seems to be evidence of general periencephalitis (chronic), and as there was absolutely no improvement under proper treatment, I had him committed to the state lunatic asylum, where he will probably pass the remainder of his days.

Such cases as these are not rare and they are not without their lesson. They teach that in *all cases* where there is even a *suspicion* that there is depression of the internal table the trephine should be employed, notwithstanding the old rule we have been wont to follow. I have used the word "suspicion" advisedly; we cannot, in many instances, be certain that there is a fracture until we cut down to see. As Moulin (*Practice of Surgery*, page 601) says: "Contusions, fissures and fractures do not always admit of proof; and even when the bone is comminuted and the depression considerable, the diagnosis is often a conjecture, owing to the amount of blood extravasated. The gravity of simple fractures arises from the fact that serious injury to important structures is so often associated with them." That I am correct is my assertion that we are justified in trephining even upon a *suspicion* of fracture is proven by the following case:

CASE III.—Tod K———, age thirteen years, fell from the bluff, a distance of 65 feet, striking upon his head. The accident occurred about 11 a. m. May 16, 1891. He was not unconscious when conveyed to his home and a physician pronounced his wound not a serious one, washed the lacerated scalp and applied an antiseptic dressing. At 1 p. m. the boy became somewhat drowsy and vomited repeatedly, at which time I was called to take charge of the case. He was quite stupid, pulse very weak, skin of a purple color, "shock" pronounced. Examination showed a cut in scalp about two inches long on the left median line, just behind the parietal eminence; but no special indication of fracture. At 3 p. m. assisted by Dr. John Wilson I shaved the scalp and enlarged the skin-cut, under chloroform anæsthesia. When the scalp was turned back an extensive fracture of the parietal bone was revealed, with depression two inches or more across. This fracture had been hidden by the scalp's slipping over it entirely and by the boggy swelling of the injured soft parts. A small opening was chiseled in the external plate and an elevator introduced; but the depressed bone could not be raised thus, so a ¾ inch trephine was applied. On removal of the button a very considerable amount of blood came from between the bone and the dura. A large spicula of the vitreous plate projected through the dura and into the brain tissue; this was removed, together with a number of fragments. There was considerable bulging of the brain through the opening and the protruded matter was pulseless. Upon raising the depressed bone into proper position the brain sank and soon pulsation returned and simultaneously the purple hue of the skin gradually disappeared. All clots and fragments having been removed the wound was irrigated with hot water (previously boiled), the wound in the dura closed by a fine catgut suture, a strip of

bi-chloride gauze placed next to the dura and projecting through scalp-wound for drainage and the cut in scalp sewed with catgut. The usual dressings were applied and patient put to bed in good condition, color and pulse greatly improved.

At 10:30 p. m. temperature normal, no pain, patient bright and cheerful and talking as if nothing had occurred. Morphine, gr. ⅛, *per orem*, if needed for sleep, was ordered.

May 17th. At 3 p. m. in fine shape—pulse 90, temp. 99. No pain; free motion in all extremities.

May 18th. Sat up while drainage was removed and dressings applied; no fever; no pain; wound in fine shape, no pus, healing nicely begun. Dressed with iodoform, bi-chloride gauze, cotton and bandage.

May 19th. Condition excellent – no pain; no fever; eats and sleeps well.

May 26th. Dressed head; wound practically well.

May 31st. Patient is running about over house. Wound entirely healed. Discharged well.

What the result would have been in this case if the so-called "conservative treatment" of the first doctor had been continued can, of course, be only a matter of conjecture. But I feel sure that if death had not occurred within a day or two, an inflammatory process would have occurred which would have necessitated operation a week or two later when there would have been far more danger; or, if this had fortunately been escaped, an epilepsy would probably have arisen in later years. The objection of Brodie which strange to say, is supported by Ashhurst, (*Principles and Practice of Surgery*, 1889, page 339) that it is better to leave imbedded in the brain, a foreign body or fragment of bone rather than use any force in its removal, is one that can not be too strongly condemned. If the surgeon be *absolutely clean*—i. e. surgically clean—he is not going to do much mischief provided he is reasonably careful. Ashhurst's assertion that meningitis and encephalitis are likely to occur from surgical handling is as utterly false as many other fallacies of ancient pathology; an experience in a large number of cases of operative brain surgery has lead me to know that inflammation is an accident due to infection prior to operation, or to carelessness on the part of the surgeon. A clean wound of the brain or of the meninges will heal without the least sign of inflammation, just as will one in the broad ligament and abdominal walls. Inflammation is not necessary to healing and should not be found in any wound made by a surgeon. As Senn says (*Principles of Surgery*, page 1): "Studied from a surgical standpoint, regeneration includes the process observed in the healing of wounds and the complete or partial restoration of parts damaged. * * * Regeneration and inflammation are distinct conditions, which should no longer be confounded or considered from the same etiological and pathological standpoint. An ideal regeneration takes place without inflammation provided the seat of injury or tissue destruction remains aseptic; that is, free from pathogenic organisms."

We being, then, able to open up the scalp freely, or the skull also,

without additional danger, I am not sure but Agnew is correct in asserting that we would be justified in operating in even simple fissure; we certainly ought to do so in every suspicious case. On the other hand, no case, unless the patient is seen to be dying, should be considered too grave for operation. An illustrative case is this:

CASE IV.—George E.———, aged twenty-four, was struck by a locomotive on the morning of April 2, 1891. During the day he was seen by at least three prominent surgeons who said that recovery was impossible and all refused to risk an operation. I saw him in consultation with Dr. W. S. Allen, at 6 p. m. At that time he was partially conscious and begged me to do something to give him even the slight chance of recovery. His appearence was frightful; the whole scalp and peritoseum was torn away, i. e. the scalp at the margin of the hair was broken loose and hung by a piece not more than three inches wide at the back of the neck; the flange of the drive-wheel had stuck him near the coronal suture on the right side, driving the bone down into and fearfully injuring the right frontal convolutions; a fracture extended downward into the orbit, widely gaping and blood was still oozing from eye and nose. This was a "diffuse injury" to the skull in which the books direct not to operate. Nevertheless he was chloroformed by Dr. Callaghan and we removed the cinders, broken bones and clots, raised the depressed bone, pushed together the bones which were separated by the long fracture from junction of saggital and lambdoidal sutures to point of crushing, and into orbit, and put in large drainage tubes, replacing scalp and holding it in place by continuous catgut suture.

April 3d. Slept nicely all night; no nausea, no fever (99+), no paralysis, but considerable frontal headache.

April 5th. Drainage removed. Patient doing well.

April 17th. Patient has made an uninterrupted recovery. Discharged from hospital well, though still weak.

In view of such an ideal result can anyone say that any case is too severe to justify an attempt to save life? Yet there are surgeons of eminence who refuse to jeopardize their reputation by operating in such cases. As for me, I believe one patient's life better than any reputation I can ever acquire as a surgeon.

To summarize the whole matter I offer the following:

RULES FOR TREPHINING IN INJURY OF THE SKULL.

1. All cases of depressed fracture, either simple or compound, require trephining and elevation, whether there be pressure symptoms or not.

2. All punctured fractures and gun-shot wounds imperatively indicate the use of the trephine.

3. In simple fracture of the skull where any symptoms of brain trouble persist exploratory operation should be done.

4. In all cases of local injury to the skull, whether fracture or bruise, followed by evidence of inflammation of bone or persistent symptoms of brain irritation, or of pus between the bone and dura, the trephine should be resorted to.

5. In every case of localized injury to the head where unconsciousness persists for more than an hour, exploratory operation, including opening the skull if necessary, should be done.

6. The appearance of stupor some hours after a head injury indicates meningeal hæmorrhage and requires trephining at the point of injury if known, or at point indicated by cerebral localization; the middle meningeal being the usual source of trouble.

7. Even in very extensive injury to the head operation should be made, since removal of *dèbris*, restoration of normal contour and cleaning of injured tissues can add but little to the danger and may save life.

8. In every case of doubt exploratory operation is justifiable.

9. Compound fractures, with or without apparent depression, demand enlargement of the wound and careful exploration.